exclusively, or more scientifically than Schimmel & Co., of Leipzig. Not content with much original work in the chemistry of these substances and costly experimentation with methods of manufacture, this firm commissioned Dr. E. Gildermeister, of Leipzig, and Dr. Fr. Hoffmann, of Berlin (the latter long and honored leader in pharmaceutical affairs in this country), to prepare a work on volatile oils,[4] treating them in an exhaustive and critical manner from the modern standpoint. This work, published about a year ago, has been translated into English by Dr. Edward Kremers, of the University of Wisconsin. The recent rapid development of the knowledge of the volatile oils makes the present volume doubly useful. With the chemistry of these bodies it happily combines much interesting historical matter and a description of the modern processes of distillation. Abundant references to original chemical sources make the work an important aid to the investigator.

Though primarly chemical and technical, the list of plants, arranged according to families, from which volatile oils are obtained will be interesting for the botanist and the whole book is a mine of information. Four hundred and thirty oils are described, the botanical sources, percentage present in various parts, mode of preparation and composition being given.—C. R. B.

NOTES FOR STUDENTS.

HAROLD L. LYON, of the University of Minnesota, has announced[5] that Nelumbo, "both in its anatomy and embryogeny conforms to the type of the monocotyledons." His full paper will be awaited with interest.—J. M. C.

LEWIN[6] contradicts the view of Stahl that raphides are important as a means of protection against herbivorous animals. There is no evidence of mechanical injury to animals, nor of poisonous effects being produced through eating plants that contain these crystals.—H. C. COWLES.

MIYOSHI[7] has performed a number of experiments in order to determine the influence of various substances in the soil or water upon flower colors. His results are not uniform, though he finds in general that aluminium compounds change lilac to blue (as Molisch previously observed), while potash changes lilac to green, and many acids change it to red.—H. C. COWLES.

W. C. WORSDELL[8] has concluded that the Bennettitales are more primitive than the modern cycads, as shown by their stem structure, radial

[4] GILDERMEISTER, E. and HOFFMANN, FR.: The volatile oils. Written under the auspices of the firm of Schimmel & Co., Leipzig. Authorized translation by EDWARD KREMERS. 8vo. pp. viii + 733, *figs. 83, maps 4*. Milwaukee: Pharmaceutical Review Pub. Co. 1900.

[5] Science **13**: 470. 1901.

[6] Ber. deut. bot. Gesell. **18**: 53–72. 1900.

[7] Bot. Centralbl. **83**: 345. 1900.

[8] The affinities of the mesozoic fossil *Bennettites Gibsonianus*. Ann. Bot. **14**: 717–721. 1900.

sporophyll, and terminal ovule. In reference to the radial character of the primitive sporophyll the author accepts Celakovsky's view, and also regards the peculiar ovuliferous stalks as foliar rather than axial structures.—J. M. C.

D. H. SCOTT[9] has described a new genus of lycopods, *Lepidocarpon* by name, which shows features indicated by the title of the paper. It is from the Lower Coal Measures and also from a much lower horizon, the Calciferous sandstone series, and the strobili resemble those of Lepidostrobus. The megasporangia, however, mature and retain a single large megaspore, and each sporangium becomes covered by a definite tegument which is an outgrowth from the sporophyll, and completely encloses it except for a slit-like opening above. So much of the sporophyll persists as is necessary to complete this testa-like covering, and the whole seed-like structure falls off with its retained and germinated megaspore.—J. M. C.

DR. E. O. JORDAN[10] has published recently a paper upon the bacterial self-purification of streams, the observations having been made during a study of the chemical and bacterial condition of the Illinois river and its tributaries, undertaken in behalf of the sanitary district of Chicago. The phase of self-purification considered is that which relates to the disappearance of the sewage bacteria. Although the conclusions are not to be regarded as final, a lessening of the bacterial content seems to admit of no question. In fact, the observations show that the Illinois river at Ottawa had become nearly free from the great mass of sewage bacteria with which it was originally laden. The probable factors in this result seem to have been dilution, sedimentation (leading to exhaustion of food supply), or action of sunlight. The influences of mechanical agitation and aeration, and of plankton, do not seem to be factors which enter into the problem in connection with the Illinois river. —J. M. C.

JOHN WEINZIRL[11] has recently published a paper upon "The bacterial flora of the semi-desert region of New Mexico with especial reference to the bacteria of the air," in which he records the result of a two-year study. Both quantitative and qualitative examinations were made. The quantitative data were obtained by the filter method, sand being used for the filtering substance. Five determinations made in the vicinity of the University of New Mexico gave an average of aboat forty-two bacteria per cubic meter of air. Eleven determinations in the residence district of Albuquerque yielded

[9] On the occurrence of a seed-like fructification in certain paleozoic lycopods. Ann. Bot. **14**: 713–717. 1900.

[10] Some observations upon the bacterial self-purification of streams. Jour. Exper. Medicine **5**: 271–314. *pl. 20.* 1900.

[11] Jour. Cin. Soc. Nat. Hist. **19**: 211–242. 1900.

an average of one hundred and forty-three per cubic meter. Comparison is made with the Mont-Souris results, but no mention is made of Tucker's observations in Boston. Ten organisms, presumably distinct, are described with some detail. It is not stated whether the "recommended procedures" have been employed. The organisms described are characterized as a whole by their inability to ferment sugar and to peptonize gelatin.—E. O. JORDAN.

MISS ETHEL SARGANT[12] has published an exceedingly interesting paper upon double fertilization, bringing together the contributions to date and discussing the questions that have been raised. The bibliography of the subject is represented now by at least eighteen titles, and the phenomenon has been recorded for about twenty-five species. The author inclines to the view that the triple fusion is a true act of fertilization between a male cell and an egg, interfered with and rendered abortive by the introduction of the non-sexual antipodal nucleus. The result is not a normal embryo, but a small and short-lived mass of tissue. Boveri's experiments with the eggs of sea urchins, in which more than one sperm was forced to unite with egg nucleus, are cited to prove this probable result of more than double fusion. The theory is advanced that the third nucleus is introduced to secure the degeneracy of the resulting tissue. If this is true, the definitive nucleus has descended from one which was the result of true fertilization, and the participation of the third nucleus is an added feature.—J. M. C.

ITEMS OF TAXONOMIC INTEREST are as follows: EDWARD L. GREENE (Pittonia **4**: 242–284. 1901), in continuing his "Studies in the Compositae," has made a special attack upon *Bidens*. After an interesting account of the history of the genus, of *B. frondosa* L., and of *B. cernua* L., he describes twenty new species, thirteen of them being American analogues of *B. cernua*, and seven of them segregates of *B. chrysanthemoides* Mx. *B. Beckii* is given generic rank, and is associated with two new species under the name *Megalodonta*. In the same fascicle new species are described under Conoclinium (3), Eupatorium (8), and Antennaria.—C. S. SARGENT (Rhodora **3**: 19–31. 1901) has described thirteen new species of *Crataegus* from the Champlain valley, remarking that this is one of the richest regions in the world for forms of Crataegus.—P. A. RYDBERG (Bull. Torr. Bot. Club **28**: 20–38. 1901), in the fourth paper of his series entitled "Studies on the Rocky mountain flora," describes new species under Arnica (2), Artemisia, Picradenia, Antennaria, Aster, Townsendia, Erigeron (3), Valeriana, Campanula, Castilleia (3), Mimulus, Pedicularis, Pentstemon (3), Polemonium, Gilia, Phacelia, Lappula, Cryptanthe, Mertensia (4), Mentzelia, Impatiens, Geranium, Lupinus (2), Astragalus, Aragallus, Trifolium, and Lathyrus.—C. V. PIPER (*ibid.* 39–45, in the fifth paper of his series entitled "New and noteworthy northwestern

[12] Recent work on the results of fertilization in angiosperms. Ann. Bot. **14**: 689–712. 1900.

plants," describes new species under Arabis, Trifolium, Astragalus, Solidago, Erigeron, Antennaria, Artemisia, Crepis, Dodecatheon, Gilia, Phacelia, Lappula, and Mimulus.—L. M. UNDERWOOD (*ibid.* 46–47) has described a new Adiantum from New Mexico.—J. M. C.

BROWN and ESCOMBE have under way one of the most important physical researches of recent years. They have set forth some of their results and have applied them to plant functions in a paper on the "Static diffusion of gases and liquids in relation to the assimilation of carbon and translocation in plants."[13] Blackman's interesting results (1895) concerning the diffusion of CO_2 through stomata are fully substantiated. The authors further find that with small openings *a*) the rate of diffusion varies as the diameter of the orifice; *b*) multiperforate septa do not hinder diffusion when the openings are about ten diameters apart; *c*) decrease in per cent. of area of holes is not followed by proportional decrease in amount of diffusion; *d*) the laws hold for both gases and solutes. Assuming an analogy with lines of force about an electrified disk, they find these results accord with mathematical calculations. Applying these principles to plants the authors conclude that 1) in an ordinary leaf (*Helianthus annuus*) the stomata are sufficient to permit the diffusion of five or six times as much as CO_2 as is actually used by the plant; 2) resistance to the absorption of a greater quantity of CO_2 lies in the relatively slow diffusion of the CO_2 after solution; 3) the stomata are more than sufficient to permit the escape of the observed amounts of water vapor by diffusion without any mass movements; 4) continuity of protoplasm may have more to do with translocation of foods than has been supposed hitherto, since over 60 per cent. of diffusion possible through an orifice the full size of the pit would take place through the many minute perforations, although their area be only 0.84 per cent. of the total membrane of the pit.—T. C. FRYE.

IN A RECENT PAPER by A. H. R. Buller[14] on chemotaxis in fern sperms it is shown that these cells are attracted not only by malic and maleic acids and several of their salts (as was known before), but also by numerous salts of the inorganic acids. Potassium and sodium tartrate and potassium oxalate also attract. Sperms of *Gymnogramme Martensii* were used and were tested by Pfeffer's method of capillary tubes. The concentration necessary for attraction is usually $\frac{1}{100}$ to $\frac{1}{10}$ normal. With malic acid it is $\frac{n}{10000}$ to $\frac{n}{1000}$, and with sodium malate $\frac{n}{1000}$ to $\frac{n}{10}$. Nitrates and chlorids of sodium, ammonium, and calcium do not attract, nor does lithium nitrate. The choice of compounds to be tested was made, apparently, with the aim of making a catalogue of attracting substances rather than of determining the real nature

[13] Phil. Trans. Roy. Soc., London, B. **193**: 223–292. 1900.

[14] Contributions to our knowledge of the physiology of the spermatozoa of ferns. Ann. Bot. **14**: 543. 1900.

of the attraction. The results are tabulated according to De Vries' obsolete isotonic coefficients, and in order to be studied need to be rearranged by base and acid. The small number of salts of any given acid makes it utterly impossible to draw any conclusion as to the nature of the attraction. The author's propositions in this regard may or may not be substantiated later; several hypotheses might be formulated which would explain equally well the cases cited. It is unfortunate that this paper (following that of Garrey[15] by nearly a year) should carry our knowledge of this important subject of chemotaxis such a little way further than it was carried by that writer. We have tried, with some success, to coordinate the results given in these two papers, but nothing definite can be attained, so far as fern sperms are concerned, until we have more data. Chemical principles must be brought into requisition in the selection of salts to be tested as well as in the interpretation of results. The author makes an interesting observation with regard to starch grains in the vesicle of these sperms. During the swarm period the grains diminish in size and often disappear entirely. The conclusion is drawn that the starch is made use of by the active sperm, being probably oxidized for the production of kinetic energy. Unhappily, no observations on the hydrolysis of these grains were made. We may suppose them to be converted into glucose by an enzyme formed in the vesicle. Thus we might have the non-nucleated cytoplasm of the sperm mother cell doing nutritive work for the moving sperm. This, if shown to be the case, might throw some light on the phenomena occurring in the male cells of the lower gymnosperms.— BURTON EDWARD LIVINGSTON.

AMONG RECENT CONTRIBUTIONS to paleobotany the following papers may be mentioned: LESTER F. WARD (20th Ann. Rep., U. S. Geol. Survey, 1900), with the collaboration of Fontaine, Wanner, and Knowlton, has published an extended account of the Triassic and Jurassic floras of the United States. The various areas are systematically treated, and much new material is incorporated. A large number of plates accompany the work, many of which illustrate Ward's recently described genus Cycadella. A similar report on the Cretaceous is to be expected soon from the same source, and will be heartily welcomed, inasmuch as the literature is considerably scattered. Ward has also published a very interesting popular report on the petrified forests of Arizona, which has been issued by the United States Geological Survey.— F. H. KNOWLTON has published on the flora of the Montana formation (Bull. 163, U. S. Geol. Survey, 1900); this together with his previous papers on fossil plants from Idaho and Yellowstone Park adds greatly to our knowledge of the late Cretaceous and early Tertiary floras of that part of the United States. —DAVID WHITE (20th Ann. Rep., U. S. Geol. Survey, 1900) has worked out

[15] The effects of ions upon the aggregation of the flagellated infusoria. Am. Jour. Phys. 3: 291. 1900.

in great detail the stratigraphic succession of the fossil floras of the Pottsville formation in the Carboniferous of Pennsylvania.—A. C. SEWARD, whose study of the fossil history of Gingko has been briefly noted in this journal (**30**: 139), has published on the Wealden flora of Bernissart (Mem. Mus. Roy. Hist. Nat. Belg., 1900); the ferns dominate in these beds rather than cycads, but there are no angiosperms, although the Wealden is commonly regarded as equivalent to the Potomac beds of our country.—GRAND 'EURY has given some very interesting accounts (Compt. Rend. **130**: 871, 988, 1167, 1366. 1900) of the Carboniferous forests of France. By his study of the plants preserved *in situ*, he concludes that most of the Calamites and some of the tree ferns grew in the water; the herbaceous ferns probably grew largely on hummocks. Even Cordaites seems to have grown in swamps, and Grand 'Eury suggests analogies with Taxodium and the Dismal swamp of today. The prevailing horizontality of the roots strikingly suggests swamp habitats. The author doubts if we have evidence of upland vegetation.—At the last meeting of the British Association (Geol. Mag., Jan. 1901) Seward, Kidston, and others discussed Carboniferous conditions, as indicated by plant fossils. Little new material was added, though Seward suggests that the xerophytic structures of Carboniferous plants may perhaps be accounted for by swamp habitats.—PENHALLOW (Brit. Assoc. Adv. Sci., 1900) has made an interesting report on the flora of the Canadian Pleistocene. Interest was aroused a few years since by Coleman's discovery of the papaw and osage orange in interglacial beds near Toronto, indicating a genial climate between ice-sheets. Over eighty Pleistocene species are now known from Canada. As Knowlton suggests in discussing this report in *Plant World* for January, there is a wide field for work in the study of Pleistocene floras in America. The poverty of our information in this respect is in striking contrast with the wealth of knowledge as to the Pleistocene of Europe.—H. C. COWLES.

THE FORMATION OF TETRADS has lately been investigated by H. O. Juel.[16] The contribution consists of three distinct papers which may be considered separately.

I. *Tetrad formation in the ovule of Larix.*—The general relationships between the reproductive organs of pteridophytes and spermatophytes have long been known, but while it is accepted that the pollen grain arises by a tetrad division, just as the spores of pteridophytes, it is generally believed that the megaspore of spermatophytes is formed without such a division. Dr. Juel studied the ovule of *Larix Sibirica* from an early stage in the development of the mother cell of the megaspore to the beginning of endosperm formation. The paper is of special interest as the first to treat this portion of the life history of a gymnosperm from the standpoint of modern

[16] Beiträge zur Kenntniss der Tetradenbildung. Jahrb. f. wiss. Bot. **35**: 626–659, *pls. 15, 16.* 1900.

cytology. In material collected about the middle of April, before the snow had disappeared, the mother cell of the megaspore is easily distinguished by its large size, and by the abundance of starch. The first division is heterotypic, and shows the reduced number (12) of chromosomes. At the poles of the spindle are granular masses which may possibly represent centrosomes, although the author is not willing to commit himself to this interpretation. During the anaphase the starch disappears, a cell wall is formed, and each of the two daughter nuclei divides, this time by a homotypic division, giving rise to a row of four megaspores, the lowest of which germinates and produces the gametophyte. By comparing this series with the development of the microspores, which has been thoroughly studied in Larix, the author reaches the conclusion that the two series are homologous, and that the megaspore, like the microspore, arises by a tetrad division. While the conclusion is not new, the evidence supporting it is valuable.

II. *The tetrad formation in a hybrid plant.*— It has long been known that hybrids are inclined to be sterile, and that the pollen of hybrid plants is commonly imperfect. The present paper deals with the formation of the tetrad in *Syringa Rothamagensis*, a hybrid between *S. vulgaris* and *S. Persica*. The form did not prove to be favorable for such a problem, because the pollen of both parents is poor, in *S. vulgaris* about 50 per cent. of the pollen grains appearing to be incapable of functioning, and in *S. Persica* normal pollen being quite rare. The latter form is almost as sterile as the hybrid. In all three forms the development is normal up to the formation of the pollen mother cells. In the hybrid it was found that while most of the divisions in these cells were mitotic, there were also numerous instances of amitotic division, and abnormalities in the chromatin and in the achromatic figure were frequent.

III. *The development of the pollen grain of Carex.*—As a rule, the pollen mother cell of a spermatophyte gives rise to four pollen grains, but it has been reported that in the Asclepiadaceae and Cyperaceae the mother cell gives rise to one pollen grain only. A careful examination of *Carex acuta* showed that the wall of the pollen mother cell becomes the wall of the pollen grain. It also showed that the tetrad divisions take place, but the walls are imperfect and only one cell of the tetrad develops into a pollen grain, the other three being crowded out, just as in the megaspore series three potential megaspores are crowded out by the one that functions.—CHARLES J. CHAMBERLAIN.